

Amendments to the Specification

Please replace the paragraph at page 3, line 1 to page 3, line 19, with the following amended paragraph:

Whether or not anomalous pulses are present in the acquired signal, the operator may wish to determine the statistics of certain measurements across a large number of pulses in the acquisition for the purpose of margins analysis. For example, the duty cycle of a clock waveform may need to be analyzed to insure that the minimum and maximum bounds are not exceeded. Some conventional systems include facilities for determining measurement statistics, however, in such implementations, the statistics are accumulated from measurements performed over multiple acquisitions and/or the results are computed such that a given measurement value is not readily traceable to the pulse it is associated with. Accumulating statistics over multiple acquisitions is disadvantageous because the acquisitions may relate to different operating conditions in the circuit or system being analyzed. Additionally, depending on how many pulses are measured from each acquisition, the ~~time~~ time spacing between measured pulses may vary significantly, making statistical understanding less straightforward. When statistics are computed without traceability to individual pulses, the operator is unable to view the particular pulse associated with the given measurement result. Without a view of the pulse, the operator is at a loss to determine ~~when~~ what caused the measurement result. In sum, in currently available signal measurement systems, it is difficult for an operator to characterize or troubleshoot a system or circuit through analysis of the large number of pulses that may be captured in a single acquisition.

Please replace the paragraph at page 11, line 13 to page 11, line 14, with the following amended paragraph:

Figure 4 is a schematic diagram of one embodiment of the pulse data array illustrated in Figure 2 and generated by the pulse database generator of Figure 3.

Please replace the paragraph at page 21, line 16 to page 21, line 23, with the following amended paragraph:

The consolidation of pulse measurement results and other pulse characteristics 212 in an accessible database provides a repository of characteristic data that was heretofore unavailable to the operator. In addition, the storage of such pulse characteristics 212 in an accessible data array provides the operator with significant capabilities to search and sort the pulse characteristics 212 to gain insights into the behavior of the system or circuit being evaluated. The operator achieves this by generating pulse data array queries 214 through user interface 116. Pulse data array queries 214 are processed by pulse analyzer 204 as described below to generate pulse data reply 216.

Please replace the paragraph at page 21, line 24 to page 22, line 4, with the following amended paragraph:

Specifically, pulse analyzer 204 searches pulse data array 206 for pulses that satisfy an operator-generated search criteria. Similarly, pulse analyzer 204 sorts the selected subset of pulses based on an operator-generated sort criteria. Pulse analyzer 204 provides the operator with a graphical user interface environment 116 in which the operator may specify the search and sort criteria and in which pulse analyzer 204 may display the selected pulses with their associated pulse measurement results. Pulse analyzer 204 can also display the results of the search and sort operations, and other information related to pulse data array 206 that is related to the operator's investigation into the acquired signal. In accordance with one embodiment of the invention, pulse data array query 214 includes queries for measurement statistics 324, and reply 216 includes the requested statistics.

Please replace the paragraph at page 24, line 18 to page 25, line 3, with the following amended paragraph:

Thus, to perform the pulse measurement operations, this embodiment of pulse database generator 202 includes a histogrammer 302 that processes acquisition data 208 to generate one or more histograms 312 of the distribution of the acquired signal voltage levels. A mode finder 304 processes histograms 312 to determine the top and base voltages 314 for each logical state of the measured pulse in the acquired signal, including the top and base voltage levels. A transition calculator 306 determines the transition voltages 316 at each specified transition percentage 332, such as the 10%, 50% and 90% levels, of the pulse

amplitude. A data analyzer 308 processes acquisition data 208 to determine the times at which each of these transitions occurs, referred to herein as transition times 318. In this illustrative embodiment, pulse database generator 202 includes a pulse measurement engine 310 that performs pulse measurements on acquisition data 208 utilizing transition times 318. The results of these pulse measurements are stored in pulse data array 206 as pulse characteristics 212. In addition, the noted global statistics of these pulse measurements are also calculated by pulse measurement engine 310 and provided to pulse data array 206 as measurement statistics 324. The functions and operations performed by each of these functional components or subsystems of pulse database generator 202 are described below.

Please replace the paragraph at page 26, line 13 to page 26, line 27, with the following amended paragraph:

In certain situations, an operator desires to use uniform top and base levels for all measured pulses. When global/local flag 329 is set to the 'global' state, a single global histogram is created for use ~~my~~ by mode finder 304. To provide for individual top and base levels for each pulse, histogrammer 302 preferably includes a pulse delineator 303. Pulse delineator 303 determines the boundaries of individual pulses when global/local flag 329 is set to the "local" state. Pulse delineator 303 first determines the overall minimum and maximum values of all acquired data 208. Then, the nominal medial (50%) value is calculated. The times the acquired data transitions through this value are then determined. A minimum amplitude requirement is used to control to effects of sampling uncertainty or internal noise. In a two logical state square wave, the transitions signify rising and falling edges of each pulse. Successive pairs of the crossing times are identified, with the mid-point between the falling edge and the rising edge calculated as the pulse boundary at the baseline level. These boundaries are then used by histogrammer 302 to develop a histogram 312 of each acquired signal pulse as described above.

Please replace the paragraph at page 31, line 23 to page 31, line 29, with the following amended paragraph:

As with top and base voltages 314 and transition voltages 316, transition times 318 may be stored in one or more data structures of any form appropriate for the performance objectives and other limitations of the particular application. In one embodiment, for each transition voltage 316, an array of time values at which the acquired signal pulses achieved

the transition voltage 316 is stored in a single data array. Thus, in the three-transition percentage example above, there would be three such data arrays, one for the 10% voltage, 50% voltage and 90% voltage thresholds.

Please replace the paragraph at page 33, line 20 to page 33, line 25, with the following amended paragraph:

Referring now to Figure 8, dialog box 800 provides a series of checkboxes 802 each associated with ~~one or more~~ a one or more signal pulse measurement identifiers 804A-804G. In the embodiment shown, certain check boxes are mapped to a single signal measurement, such as rise time 804A and fall time 804B. Other checkboxes are mapped to more than one signal measurement. For example, ~~measurement-selection~~ the sixth checkbox from the top, checkbox 802F, is mapped to all signal measurements, as indicated by the identifier 804F of "All."

Please replace the paragraph at page 38, line 18 to page 39, line 5, with the following amended paragraph:

At decision block 1208 information may be provided by the operator. The operations that occur thereafter are a function of the types of information that is provided to the operator. That is, information required to perform the noted pulse measurement operations may either be provided by the operator or calculated. In this example, the information provided by the operator could be information made available by the manufacturer of the system or circuit being evaluated or other sources. Such information eliminates the need for pulse database generator 202 to execute certain processes to determine the same information. In this example, the operator is presented with three options in this regard. The first is that the operator provides transition percentages 332. As noted, transition percentages 332 determine the voltage threshold levels achieved by a pulse rising edge or a pulse falling edge that are utilized to make a pulse measurement. In such a circumstance the series of operations beginning at block 1214 is performed. Another option is that the operator provides global top and base voltages 314 in addition to the transition percentages 332. This results in the performance of the operations beginning at block 1210. Finally, the operator can provide global transition voltages 316 only, eliminating many of the operations that would otherwise be performed. The three paths through process 1200 are illustrated in three vertical columns, with blocks related to the same or similar data located adjacent to each other.

Please replace the paragraph at page 39, line 6 to page 39, line 10, with the following amended paragraph:

If the operator provides transition percentages only at block 1208, the processing continues at block 1214 at which the transition percentages are received. In the illustrative embodiment, the transition percentages are provided by the operator through user interface 116. In an alternative embodiment, transition percentages can be fixed values or included in a system configuration file. The global/local flag is received at ~~block 1225~~ block 1215.

Please replace the paragraph at page 39, line 16 to page 39, line 21, with the following amended paragraph:

At block 1218, acquisition data 208 is processed to determine the top, base and other voltage levels having logical significance based on the modal distribution of the histograms generated at block 1216 and the type of pulse train received at block 1206. In the illustrative embodiment, this includes the top and base voltage levels 314. As noted, however, more or less such voltage levels may be determined based on the pulse train type 330 received at block 1206.

Please replace the paragraph at page 39, line 22 to page 39, line 25, with the following amended paragraph:

The voltages corresponding to the transition percentages 332 received at block 1214 are calculated at block 1220. These transition voltages 316 are calculated for the transition percentages 332 received at block 1214 relative to the top and base voltages 314 calculated at block 1218 for the type of pulse train 330 identified at block 1206.

Please replace the paragraph at page 39, line 26 to page 40, line 2, with the following amended paragraph:

Returning to decision block 1208, should the operator provide top and base voltage values 314 in addition to transition percentages 332, then processing continues at block 1210 at which the transition percentages 332 are received. This is similar to the process described above with reference to block 1214. Then, the global top and base voltages 314 are received

from the operator at block 1212. This is in lieu of calculating the top and base voltages 314, as described above with reference to block 1218. Processing then continues at block 1220, as shown in Figure 12.

Please replace the paragraph at page 40, line 3 to page 40, line 10, with the following amended paragraph:

Should the operator provide global transition voltages 316 at block 1208, then the processes depicted in connection with 1214 through 1220 need not be performed. Rather, at block 1222 the global transition voltages 316 are received and processing continues at block 1224. In the illustrative embodiment, the global transition voltages are provided by the operator through user interface 116. In alternative embodiments, transition voltages are provided using other well-known techniques, such as being fixed values, or included in a system configuration file. Processing then continues at block 1224, as shown in Figure 12.

Please replace the paragraph at page 40, line 11 to page 40, line 16, with the following amended paragraph:

Regardless of the path taken, once the local or global transition voltages 316 have been determined, then the time of occurrence at which each of the transition voltages 316 is achieved is determined at block 1224 by accessing acquisition data 208. With access to the transition time 318 and voltages 316 as well as acquisition data 208, the signal pulse measurements are computed at block 1226. The results of these measurements are stored in pulse data array 206 at block 1228. Process 1200 then ceases at block 1230.

Please replace the paragraph at page 42, line 12 to page 42, line 22, with the following amended paragraph:

Referring to search criterion 902A, a characteristic data entry field 906A is provided to receive an entry of the pulse characteristic 212 which is to be the subject of criterion 902A. A pull-down menu 908 provides the operator with the option of entering the pulse characteristic 212 directly, or to select an item from menu 908. Pull-down menu 908 is displayed in response to the operator double clicking the pointing device while the cursor is located within data entry field 906A, or by selecting the menu button 910 adjacent to data field 906. In the limited example shown in Figure 9A, characteristic data entry field 906A

has a pull-down menu 908 that provides center time 408 and a few pulse measurements 410 as the options available to the operator to select from. It should be understood that the available options are preferably consistent with the characteristics 212 stored in pulse data array 206.

Please replace the paragraph at page 43, line 8 to page 43, line 17, with the following amended paragraph:

Depending on the size of dialog box 900 and the space available on graphical user interface 116, additional criteria 902 may be presented in dialog box 900. Alternatively, additional criteria can be specified through a second dialog box (not shown) which is displayed on display 112 in response to the operator selecting the "Additional Search Criteria" button 904. The data entered into such subsequent dialog boxes will be combined with the criteria 902A and 902B as specified by the operator through dialog box 900 and/or the subsequent dialog box. To make such a combination, the subsequent dialog box would require a Boolean connector field similar to field 926 to logically connect the ~~criteria 901A~~ criteria 902A and 902B to the criteria/criterion set out in the second dialog box.

Please replace the paragraph at page 45, line 22 to page 45, line 28, with the following amended paragraph:

Returning to Figure 5, upon receipt of a search query 520, searcher 502 accesses pulse data array 206 with a pulse number request 534 and retrieves pulse information 536 associated with the queried pulse number 534. Searcher 502 successively processes the pulses in pulse data array 206, comparing relevant portions of the returned pulse information 536 with search criteria 520. For those pulses that have associated pulse characteristics 212 that satisfy the current search criteria, searcher 502 places the corresponding pulse number 404 into ~~search~~ subset index array 510.

Please replace the paragraph at page 45, line 29 to page 46, line 10, with the following amended paragraph:

The structure of ~~search~~ subset index array 510 will be described with reference to an illustrative search of the above-noted exemplary acquisition data 208. Recall that the first

measurement yielded a pulse train of 1075 pulses. Pulse database generator 202 processes acquisition data 208 to generate pulse data array 206 containing the measurements 410 for the 1075 pulses along with the center time 408 and pulse type 406 of each pulse. In addition, global measurement statistics 324 are also stored in pulse data array 206. Pulse analyzer 204 searches pulse data array 206 by generating pulse numbers 534 ranging from 1 to 1075, retrieving the associated pulse information stored in pulse data array 206. Searcher 502 then filters each pulse based on search criteria 520, storing pulse number 534 of each pulse that satisfies the search criteria in subset index array 510. Figure 6 is a diagram of exemplary search arrays 516, including an exemplary ~~search~~ subset index array 602.

Please replace the paragraph at page 46, line 17 to page 46, line 26, with the following amended paragraph:

Of the 1075 pulses in pulse data array 206, the results of the exemplary search yielded 7 pulses; that is, of the 1075 acquired pulses, 7 pulses satisfied the specified search criteria 520. The exemplary subset index array 602 includes a subset index 608 ranging from 1 to 7, sequentially numbered with the associated pulses numbers 404 ordered from the smallest pulse number to the largest; that is, subset array 602 is simply a time-ordered list. Thus, pulse numbers 5, 27, 180, 324, 641, 850 and 972 are stored in subset array 602 with subset indices 608 of 1-7, respectively. Called out ~~in-sort~~ in subset index array 602 are three particular pulse numbers 7A-7C which are described below with reference to Figures 7A-7C. Also, the relationship between ~~search~~ subset index array 602 and the other arrays illustrated in Figure 6 is described below.

Please replace the paragraph at page 47, line 2 to page 47, line 9, with the following amended paragraph:

As noted, pulse analyzer 204 provides the operator with the capability to sort the selected subset of acquired pulses identified in subset index array 510. Sorter 504 sorts this subset of pulses in accordance with sort criteria 524, and generates a sort index array 512. Sort index array 512 is a sorted list of indices into subset index ~~array 410~~ array 510, ordered in accordance with sort criteria 524. In certain embodiments, sorter 504 also generates a cross reference array 514 that includes a list of sort array indices 612 indexed by subset array indices 608, providing backward mapping from sort index array 512 to subset index array

510. This is described in greater detail below.

Please replace the paragraph at page 47, line 29 to page 48, line 7, with the following amended paragraph:

In operation, sorter 504 accesses subset index array 510 and retrieves sequentially each pulse number 404 stored therein. Sorter 504 then accesses pulse data array 206 with the retrieved pulse number 404. This is illustrated in Figure 5 as pulse ~~information request~~ number 534. Sorter 504 retrieves the relevant pulse characteristics for the queried pulse number 404, as indicated by pulse information 536. Sorter 504 then applies sort criteria 524, assigning a subset index 608 to the ~~subset index 608~~ sort index 612 associated with the pulse number such that the pulse is in the appropriate relative order in sort index array 512. This process is repeated for all pulses identified in subset index array 510, with the order of the pulses changing as appropriate.

Please replace the paragraph at page 54, line 8 to page 54, line 17, with the following amended paragraph:

This change in the displayed value of the occurrence number 706 from the value displayed in window 702A to the value displayed in the window 702B causes the transfer of a search occurrence number 528 having a value of 4 from user interface 116 to pulse locator 506. Upon receipt of this value, pulse locator 506 accesses search arrays 516 to retrieve the sort index 612 and pulse number 404 associated with the requested occurrence number 706 of 4. Specifically, pulse locator 506 accesses subset index array 602 with a subset index 608 of 4. This is identified by reference arrow 7B. Pulse number 404 associated with this subset index is pulse number 324. As shown in Figure 7B, pulse locator 506 transfers a pulse ~~number 526~~ number 534 of 324 to user interface 116. This, in turn, causes pulse number field 704B to display pulse number 324

Please replace the paragraph at page 54, line 18 to page 54, line 26, with the following amended paragraph:

Pulse ~~locator 606~~ locator 506 then accesses cross-reference array 606 with subset index 608 of 4 to retrieve the corresponding sort index value 612. As shown by reference line 7B, sort index 612 associated with a subset index 608 of 4 is 6. That is, the sixth element of sort index array 604 corresponds with pulse number 324. This is illustrated in Figure 6 by reference arrow 7B identifying the sort index ~~array 606~~ array 604 element having a sort index of 6 and a subset index of 4. The sort index value of 6 is transferred from pulse locator 506 to user interface 116 as sorted occurrence number 530. User interface 116 displays this value in sorted occurrence number field 708B, as shown in Figure 7B.

Please replace the paragraph at page 55, line 16 to page 55, line 26, with the following amended paragraph:

This change in the displayed value of the sorted occurrence ~~number 706~~ number 708 from the value displayed in window 702B to the value displayed in the window 702C causes the transfer of a sorted occurrence number 530 having a value of 7 from user interface 116 to pulse locator 506. Upon receipt of this value, pulse locator 506 accesses search arrays 516 to retrieve the ~~search~~ subset index 608 and pulse number 404 associated with the requested sorted occurrence number 708 of 7. Specifically, pulse locator 506 accesses sort index array 604 with a sort index 612 of 7. This is identified by reference arrow 7C. Subset index 608 associated with a sort index of 7 is the subset index of 2. This is shown in Figure 6 as reference arrow 7C identifying the seventh element in sort index array 604. As shown in Figure 7C, pulse locator 506 transfers a subset index 608 to user interface 116 as search occurrence number 528. This, in turn, causes ~~pulse number field 706C~~ sorted number field 708C to display an occurrence number of 7.

Please replace the paragraph at page 55, line 28 to page 56, line 6, with the following amended paragraph:

Pulse ~~locator 606~~ locator 506 then accesses subset index array 602 with subset index 608 of 2 to retrieve the corresponding pulse number value 404. As shown by reference line 7C, pulse number 404 associated with a subset index 608 of 2 is 27. That is, the second element of subset index array 602 corresponds with pulse number 27. This is illustrated in Figure 6 by reference arrow 7C identifying the subset index array 602 element having a subset index of 2 and a pulse number of 27. The pulse number 404 value of 27 is transferred from pulse locator 506 to user interface 116 as ~~pulse number 526~~ pulse number 534. User interface 116 displays this value in pulse number field 704C, as shown in Figure 7C.